

Remarks:

This amendment is submitted in an earnest effort to advance this case to issue without delay. The examiner has indicated that the case contains allowable subject matter.

The specification has been amended to eliminate some minor obvious errors. No new matter whatsoever has been added. The translated claims have also been amended to better comply with US practice.

Claim 6, which originally depended directly from independent claim 1, has been indicated to contain allowable subject matter. Accordingly this amendment adds a new claim 13 that contains all the features of original claims 1 and 6. This claim is therefore allowable outright.

Claim 1 has been amended to define the invention with somewhat greater particularity over the art. More particularly this claim now recites as shown in the drawing a cutter of a rotary pump for liquids containing solid materials, the cutter having a rotating blade 2 having at least one opening 5 through which the liquid flows and having a convex end face 8 surrounding the opening 5;

a cutting edge 7 on the blade 2, bounding the opening 5, and flush with the convex end face 8; and

a nonrotating counter surface 9 that also has at least one opening 12 through which the liquid flows, that aligns with the blade opening 5 on rotation of the blade 2, that is directed toward and closely juxtaposed with the convex end face 8 of the blade 2, and that is complementarily concave to the end face 8 of the blade 2.

Thus claim 1 now makes it clear that this invention is a cutting tool, not a grinder, with a cutting edge extending along an edge of an opening in a rotating blade, and cooperating with another surface having an opening alignable with the opening the cutting edge bounds. As stated in the original disclosure, the purpose of this cutter is to chop up items, in particular sanitary items, that might jam the pump.

The two references -- US 2,699,295 of Page and 3,961,758 of Morgan -- relate to grinders. Grinding and cutting are different processes. Grinding typically involves abrasively removing material as particles; cutting is severing through something.

Page relates to a device for grinding gold-containing ore with mercury. An ore slurry is fed into the top of a tubular shaft and issues from the bottom of this shaft where it is crushed and ground against a cup-shaped element 6. The lighter fraction rises

up between the grinder 5 and the element 6 and the heavy fraction including the gold particles and mercury can be drawn off at 1b. There are no openings in the element 6 alignable with openings in the grinder 5. Neither are there openings "through which liquid flows" in the grinder 5. Here the grinder 5 is itself a centrifugal axial-input radial-output pump. Thus this structure is physically different from what is defined in amended claim 1 and is intended for a different purpose. No rejection is possible on Page.

Morgan is somewhat better art. This reference is another grinder that also acts like a pump, just like Page. It has an element whose lower portion is cylindrical and does the grinding and whose upper portion is frustoconical and serves as a pump. Thus the only part even vaguely comparable to the convex rotary blade of this invention is the cylindrical grinding stone 35 (FIGS. 2 and 3). There is nothing resembling holes in the rotary blade, neither can anything like cutting edges bounding the holes be seen. This reference therefore like Page fails to show explicitly claimed subject matter in amended claim 1.

Enclosed herewith is a PTO-1449 listing German patent 4438841 of Ludewig, recently turned up in the PCT search. It shows a cutter for a pump, so is in fact art that is much more analogous than Page and Morgan. The PCT claims, which are broader than those now in the US case, were allowed over this reference.

No §102 rejection is possible on Page or Morgan. The combined teachings do not suggest alignable holes in two elements, one rotatable and one not, with one of the openings being bounded by a cutting edge. Thus a §103 rejection is out of the question also.

If only minor problems that could be corrected by means of a telephone conference stand in the way of allowance of this case, the examiner is invited to call the undersigned to make the necessary corrections.

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Enclosure: Marked Specification
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CUTTER FOR ROTARY PUMP

CROSS REFERENCE TO RELATED APPLICATIONS

This application is the US national phase of PCT application PCT/EP2005/000150, filed 11 January 2005, published 25 August 2005 as WO 2005/078286, and claiming the priority of German patent application 102004007739.8 itself filed 16 February 2004, the entire disclosures of which are herewith incorporated by reference.

FIELD OF THE INVENTION

The invention relates to a cutter of a rotary pump for liquids containing solid materials, the cutter having a rotating blade having at least one opening through which the liquid flows and that forms a cutting edge, and wherein the blade has one end face directed toward a nonrotating counter surface that also has at least one opening through which the liquid passes.

BACKGROUND OF THE INVENTION

It is known to provide the impeller of a rotary pump with a cutter mounted on its inlet for comminuting solids contained in the transported liquid for the pump so the downstream pipes and devices are not plugged. In these rotary pumps, the impeller shaft normally is supported only adjacent the drive motor, so that the cutter vibrates on the shaft bearing that is near the pump impeller while cutting the solids to small pieces. In addition, during operation of rotary pumps, a radial force is applied on the impeller that thus applies an alternate bending to the impeller shaft. Due to this fact, friction occurs at least between the

outer end faces of the rotating blade and the counter surface of the abutting, nonrotating element, as well as often in the outer edge, so that premature wear results. On the side that is diametrically opposite the friction point, the clearance is enlarged and thus, the danger of plugging due to solids that have not been cut is increased.

OBJECT OF THE INVENTION

The object of the invention is improving a cutter of a rotary pump such that low wear occurs while at the same time providing high cutting performance.

SUMMARY OF THE INVENTION

This object is attained according to the invention by the fact that the end face that is directed at the counter surface of the blade is convex and the counter surface is also concave.

Such a cutter has low wear since the surfaces can slide past each other without contact. This way, it is also assured that the cutter and the pump are not plugged and in particular long foreign bodies do not wrap around the blade and the impeller. When supported in a safe manner, it is easy to fabricate and assemble such cutter and a rotary pump. ~~Advantageous designs of the invention are cited in the dependent claims.~~

BRIEF DESCRIPTION OF THE DRAWING

Two embodiments of the invention are represented in the drawings and will be described in detail in the following. In the drawings:

FIG. 1 is an axial section through a cutter of a first design;

FIG. 2 is an end view of the rotating blade according to FIG. 1;

FIG. 3 is a perspective view of the rotating blade in reduced scale;

5 FIG. 4 is an end view of the nonrotating element;

FIG. 5 is a perspective view of the nonrotating element in reduced scale;

FIG. 6 is an axial section of the cutter of a second design;

10 FIG. 7 is an end view of the rotating blade according to FIG. 6;

FIG. 8 is a perspective view of the rotating blade according to FIG. 7;

15 FIG. 9 is an end view of the nonrotating element of the second design;

FIG. 10 is a perspective view of the nonrotating element of the second design in reduced scale.

SPECIFIC DESCRIPTION

The cutter 1 of a rotary motor pump has a rotating blade 2 that is attached on the end of the pump impeller that is directed away from the electric drive motor. The blade 2 is designed cup-shaped and its upper edge rim surrounds the bush-shaped inlet opening of the impeller. Herein, the upper [[edge]] rim 3 preferably has an internal thread 4 or a press fit by means of which it can be screwed onto or pressed into the external thread or the cylindrical support of the impeller inlet opening.

The bottom of the blade 2 has three inlet openings 5 that are separated from each other by means of webs 6 on which radial cutting edges 7 are attached, in particular molded thereto. The cutting edges 7 thus form angles of 120° with each other.

5 The inlet openings 5 are shaped to extend at an angle to the rotational direction and thus, are set diagonal relative to the rotational axis, so that the blade 2 has the function of an "axial impeller."

10 The bottom end and thus the end of the blade 2 that is directed away from the impeller forms a convex end face 8 formed by a part of a spherical surface, so that the blade 2 in the area that is directed away from the impeller forms a spherical cap or dome. The edges of the cutting edges 7 are situated in the end face 8, so 15 that these are curved. A radius R of the end face 8 has its end directed away from the end face 8 on the axis of the pump shaft at the same level as the pump shaft bearing that is adjacent the pump impeller.

20 The nonrotating element 10 shown in FIGS. 4 and 5 has two sector-shaped flow-through openings 12 that work together by means of their edges with the cutting edges 7. In the second embodiment, the cross-sections of the flow-through openings 12 are larger on the end that is directed away from the impeller than on the end facing toward the impeller. This way, a safe transport of swelling solids, in particular of hygiene articles, is assured.

25 A counter surface 9 of [[a]] the nonrotating element 10 abuts the end face 8, the element 10 forming a concave recess that is formed according complementary to the end face 8 and thus

possesses the same radius R, if a normally small gap between the surfaces 8 and 9 is neglected.

In the second design, the nonrotating element 10 is provided in its center between the flow-through openings 12 with an inlet tip 13 that is similar to the rotor cap and that projects to the inlet end (FIG. 6 and 7), so as to avoid plugging of the cutter upstream of the cutting plane. By means of the inlet tip, solids, in particular textiles, are conveyed to the flow-through openings instead of remaining in the center between the flow-through openings in front of the nonrotating element.

The element 10 that is circular on its outer edge is mounted in an annular flange 11 that is attached in the pump housing, in particular screwed onto it. Element 10 and flange 11 can also be designed as an integral piece.